D0 Run IIb Test Card aka "Purple Card"

D0 NoteNNNN
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This card is used in test stands for testing and burn-in of Run IIb hybrids and detectors. It buffers and translates signals between the stand-alone sequencer (SASEQ), a two-channel 6U version of the sequencer module which uses TTL logic, and the hybrids employing the SVX4 chip, which uses 2.5v differential logic. The Purple Card has a connector for one 50-conductor 3M cable from a SASEQ, and two output AVX connectors for jumper cables. The six-layer purple card is 6 x 7.75", and has impedance control for data lines on the TTL side.

Features:

1) Two channels per circuit board (same as SASEQ). This means two hybrids per purple card.

2) **Power:**

- Voltage regulation of SVX4 power, where the SVX4 voltage on/off is controlled by HDI enable/disable issued from the SASEQ. LEDs indicate power status (on if LED is lit). Test points (J23) are supplied to allow checking of output voltages via well-shielded high impedance oscilloscope leads or DVM. Voltage drop across the regulator is 1.3V, so the input voltage(s) for SVX4 power need to account for this. 4.5V at the supply is recommended.

- SVX4 and board power are fused with small cartridge type fuses, NANO 1A Slo-Blo.

- One power connector (Molex 12pin Mini-Fit Jr) is provided with separate SVX power for each channel (pre-regulator AVDD_A, DVDD_A, AVDD_B, DVDD_B, nominally 4.5V each) with provision for jumpering these supplies on the board, so that both channels can be run with the same supplies.

- The total current draws are 100mA for each SVX4 chip (thus 2A for two 10-chip hybrids), and ~0.35A or more for the purple card (not well known: may depend on type and number of hybrids).

- Output voltage of the voltage regulators is adjustable via potentiometers, thus screwdriver adjustable. **Be careful! Make sure the output voltage is in the operating range you want. The range of adjustment is 1.81-2.83V. Normal operating voltage range for DVDD is 2.25-2.75V, and for AVDD 2.25-2.75V.**

- More information can be found in appendix A.

4) Temperature monitor(two 2-pin headers, J27 and J41): DC voltage out covering range -20 to 50 degrees centigrade. The target device is VMIC VMIVME3113 ADC, which provides 8 bit digitization, and 64 inputs. Temperature measurement error is specified to +-2^{0}C. More precise measurement is possible with calibration. The assumed temperature measuring device is the same 1000Ω platinum RTD used in Run2a. Full range of Vout will be 0-1v, so that x10 gain mode of VMIC ADC will need to be used. Vout= 50mV corresponds to –20 degrees, Vout=+1.05V to +50 degrees. A typical voltage to temperature correspondence (Purple Card #006) is

$$T = 70.14*V - 23.9,$$

where T is in degrees Celsius. See also appendix B. If no RTD is present, the impedance is infinite and V_out will be ~5V.

5) HV (silicon bias) supplied via an SHV connector, and controlled by HDI enable/disable from the SASEQ (300V max.). HV is passed thru to the digital jumper cable. Provision is made for 1kV bias path with jumpers to select between 0-300V switched bias and 1kV bias. No switching is provided for 1kV.

6) CAL-SR: two LEMO connectors for convenience. These signals are passed thru passively.

7) **Dvalid delay** provision; SIP for rev 1; Rev 2- jumpers J54 and J55 respectively for channel B and A. Minimum delay is with jumper in 13-14, maximum delay (6 passes through the ABT transceiver at 2.3ns per pass) in position 1-2. See pp10 or 11 in schematic.

8) clock conversion from TTL to low-voltage differential

9) one input 50-conductor connector from SASEQ or sequencer

10) two pairs of output connectors- digital jumper.

11) Debugging: headers are provided for access to the data and control lines for each hybrid chain (see the schematic- J42, 43, 44 for channel A, J45-47 for channel B). These are on the SASEQ side of the circuit, thus TTL levels. Pins are labeled on the board.

Purple Card revision history:
Rev 1: Serial numbers 001-006
Rev 2: Serial numbers 007- to be determined.

Appendix A: power to the purple. LED display, pin outs.

Table. LED Display. Layout as viewed with purple card lying flat, with AVX connector on top. When power supplies are first turned on the items in green(D1,2,6,7) should light up. The balance of the LEDs light when HDI enable is successfully asserted.

	D1	D2	D3	D4	D12	D6	D7	D8	D9	D15
A	AVDD_B_IN	VCC_B	LVD_B_OK	DVDD_B_OK	HDI_EN_B	AVDD_A_IN	VCC_A	LVD_A_OK	DVDD_A_OK	HDI_EN_A
B	DVDD_B_IN	VA_B_IN	AVDD_B_OK	VA_B_OK	PWR_EN_B	DVDD_A_IN	VA_A_IN	AVDD_A_OK	VA_A_OK	PWR_EN_A

Definitions (channel B):

AVDD_B_IN: input voltage for AVDD. Should be > 4V, and < 6V. Low is better (heat). 4.5V is OK.

DVDD_B_IN: “ “ DVDD “ “ “ “ “ “

VCC_B: input voltage to power channel B of the purple card. Should be 5.1V.

VA_B_IN: control voltage used by channel B. Can be the same supply as VCC.

LVD_B:

AVDD_B_OK:

DVDD_B_OK:

HDI_EN_B: HDI enable present (asserted by SASEQ)

PWR_EN_B: all of the above conditions

1) Power connector

Item	Molex Connector pin
AVDD _A	2
DVDD_A	4
VCC_A, VA_A	6
VCC_B, VA_B	8
AVDD_B	10
DVDD_B	12

Pins 1,3,5,7,9,11 ground. Pin 1 is upper left.
Jumper 11: shorts pins 6-8 (so Vcc is then supplied by one power supply)
Jumper 12: shorts pins 4-12 (DVDD " " " ")
Jumper 13: shorts pins 2-10 (AVDD " " " ")
AVDD and DVDD can be connected together to the same power supply if desired.

2) Voltage test points (J28)

	J28 pin
Ground	1
AVDD_A	2
DVDD_A	3
VCC_A	4
VCC_B	5
AVDD_B	6
DVDD_B	7
Ground	8

3) Fuse test points (J5)

	J5 pin
Ground	1
DVDD_B	2
AVDD_B	3
VCC_B	4
VCC_A	5
DVDD_A	6
AVDD_A	7
Ground	8

4) Post regulator power test points (so you can see what the SVX4 is getting!).
See J23 and J19.

	J23 pin
AVDD_A (regulated)	1
DVDD_A "	3
LVD_A	5
VA_A	7

	J19 pin
AVDD_B (regulated)	9
DVDD_B "	7
LVD_B	5
VA_B	3

Appendix B: Measuring temperature (note from T. Sobering)

D0 uses 1000 ohm platinum resistors (RTD) for measuring temperature on hybrids and for other purposes. The resistance of an RTD varies linearly (more or less) with temperature, typically 0.00385ohm/ohm/C.

Pin one on J27 (and J41 for channel B) is the output voltage of the temperature circuit. Pin 2 is ground.

The circuit works by comparing the RTD temperature to a 909 ohm 1% "reference" resistor. The temperature range of interest was from -20C to 50C. The RTD resistance at -20C is 923 ohms, 1k at 0C, and 1.193k at 50C. 909 was selected for the reference so that we have some offset from 0V (a requirement of the analog circuitry -- the amplifiers cannot get all the way to ground). The RTD resistance is given by:

RTD(T) = RTD(0) + T x RTD(0) x 0.00385 ohm/ohm/C

RTD(0) = 1kohm

So, ideally 909 ohms corresponds to -23.64C.

The ideal transfer function of the circuit is:

Vout = I_ref x (RTD(T) - R_ref) x ((100k/R_g) + 1) + V_offset

where

I_ref ~ 200 uA
R_g ~ 5.76k
R_ref ~ 909
V_offset ~ .5 mV typical, 6.5mV max

The values are approximate because the resistors are +/- 1% tolerance and the current reference has 1-2% error. There are resistors provided for trimming these errors if required (for channel A - R75 for offset and R83 for gain), but it may not be necessary since we can calibrate to achieve the +/- 2C error that was specified. The units we have tested have shown small gain errors and larger offset errors, but are very linear. See the attached spreadsheet for one set of test data. One channel is almost exactly on the theoretical curve, the other shows an offset. To get these curves, we used a resistance substitution box in place of an RTD and then measured the R-box resistance (never trust the dial setting on an R-box). The problem I have seen with trying to measure with an RTD is getting an accurate temperature measurement of the RTD for correlation.

When we build the next set, I think I will have my tech do a first order calibration to minimize the offset variation.

If you have any questions, feel free to contact me.

Tim

Appendix C Board Setup

Appendix D The schematic